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(54) **Method for preparing carpets having primary and secondary fabric backings.**

(57) This invention relates to a novel process for making a carpet having a secondary backing which is substantially impervious to liquids. The process involves applying a thermoplastic resin in a film form to the surface of a secondary backing fabric or to its underside and applying a polymeric latex to the underside of a primary backing. The invention also includes carpets made from such a process.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a novel process for making a carpet having a secondary backing which is substantially impervious to liquids. The process involves applying a thermoplastic resin in a film form to the surface of a secondary backing fabric or to its underside. The invention also encompasses carpets prepared from such a process.

Description of Related Art

Many residential and commercial carpets are constructed in the following general manner. Carpet pile yarn is first inserted through a primary backing fabric to form tufts of yarn projecting from the surface of the fabric. The primary backing is then coated with a polymeric latex to encapsulate the yarn tufts in place and to provide an adhesive for a secondary backing fabric. The latex-coated primary backing is then bonded to the secondary backing to form a laminated backing structure. Carpets having such a structure demonstrate good dimensional stability, i.e., the carpet generally retains its size and shape after being installed in a residence or commercial building. Moreover, these carpets have good tuft binding strength, i.e., the tufts may not be readily pulled from the carpet face.

However, one problem with the above-described carpets is their susceptibility to liquid penetration. For instance, if water or a water-based substance (soda pop, coffee, urine, etc.) is spilled onto the carpet face, it may permeate through the primary and secondary backings and onto the underlying material (carpet underpad, hardwood floors, etc.). The underlying material may become stained and over a period of time, deteriorate and rot.

Those skilled in the trade have considered some possible ways for improving the backing structure in order to avoid such liquid permeability problems.

For instance, Ucci, U.S. Patents 4,643,930 and 4,579,762, disclose a carpet structure comprising a primary backing coated with a latex adhesive composition, wherein the primary backing is bonded to a secondary backing. The latex adhesive composition contains a fluorochemical compound for rendering the primary backing substantially impervious to water.

Others in the trade have been concerned with modifying a carpet backing system in order to improve the binding strength and encapsulation of the yarn tufts.

For instance, Ballard, U.S. Patent 3,940,525 describes a process, whereby a tufted primary backing is coated with a hot melt adhesive comprising an ethylene/vinyl acetate copolymer, wax, and a thermoplastic resin. The primary backing is then pressed against a film of polyethylene, polypropylene, or ethylene/vinyl acetate copolymer to form a finished carpet. No secondary backing fabric is used in the backing structure. The carpets are described as having improved tuft pulling strength.

Reith, U.S. Patent 4,939,036 discloses a process, where a composite hot melt adhesive in a film form is inserted between a tufted primary carpet backing and a secondary backing. The backings are then laminated together to form a tufted pile carpet. The carpets are described as having good tuft encapsulation, tuft binding strength, and delamination strength.

Published Japanese Kokai Patent Application No. SHO 59[1984]-168190 is directed towards improving the adhesion between a tufted primary backing coated with latex, and a secondary backing woven fabric made from polypropylene flat yarns. A process, wherein the polypropylene flat yarns are coated with an aqueous emulsion containing ethylene-vinyl acetate copolymer and chlorinated polypropylene is described.

Now, in accordance with this invention, a novel process for constructing a carpet has been found. Carpets prepared from this process have a secondary backing which is substantially impervious to liquids and have excellent dimensional stability.

SUMMARY OF THE INVENTION

This invention provides a process for constructing a carpet involving the following steps: 1) pile yarn is drawn through a primary backing fabric to form tufts of yarn projecting from the fabric's surface; 2) a latex is applied to the underside of the primary backing; 3) a thermoplastic resin, in a film form, is applied to the surface of the secondary backing; and 4) the primary and secondary backings are bonded together to form a carpet having a secondary backing which is substantially impervious to liquids.

Suitable polymers for the latex include styrene/butadiene copolymers, ethylene/vinyl acetate copolymers, and polyacrylates. Preferably the latex is composed of a styrene/butadiene copolymer, and

about 22 to 32 oz/yd^2 of latex is applied to the primary backing. Suitable polymers for the thermoplastic resin include ethylene/vinyl acetate copolymers, polyethylene, and polypropylene. Preferably, the thermoplastic resin is an ethylene/vinyl acetate copolymer film, and about 0.25 to 2.5 oz/yd^2 of resin is extruded onto the secondary backing fabric.

Typical primary and secondary backing fabrics for use in this invention include polypropylene, jute, and polyester fabrics. Both woven and nonwoven fabrics may be used.

In another embodiment of this invention, the thermoplastic resin may be applied to the underside of the secondary backing fabric, rather than to its surface.

This invention is also directed to carpets prepared from the above-described processes.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a process for constructing a carpet having a primary fabric backing and a secondary fabric backing. The carpets are characterized by having a secondary backing which is substantially impervious to liquids.

Generally, the pile yarns for such carpets may be prepared by conventional techniques. These yarns are composed of multiple filaments which are formed from synthetic or natural polymers. Typical fiber-forming polymers include, for example, polyolefins such as polypropylene, polyamides such as polyhexamethylenediamine adipamide (nylon 66) and polycaprolactam (nylon 6), and polyesters such as polyethylene terephthalate. Copolymers, terpolymers, and melt blends of such polymers are also suitable.

In a nylon filament-forming process, the molten polymer is extruded through a spinneret into a quenching medium, where the polymer cools and solidifies to form filaments. Typically, the molten polymer is extruded into a quench chimney where chilled air is blown against the newly formed hot filaments. The filaments are pulled through the quench zone by means of a feed roll and treated with a spin-draw finish from a finish applicator. The filaments are then passed over heated draw rolls. Subsequently, the filaments may be crimped and cut into short lengths to make staple fiber, or bulked to make bulked continuous filaments (BCF). Crimping of the yarn may be conducted by such techniques as gear-crimping or stuffer box crimping. Hot air jet-bulking methods, as described in Breen and Lauterbach, United States Patent 3,186,155, may be employed to bulk the yarn. The resulting singles yarns may be ply-twisted together and then subjected to a heat-setting operation.

The yarns may then be tufted into a primary backing fabric by techniques known in the trade. Generally, in such a process, needles push the yarn through the underside of the fabric to form loops of yarn projecting from the fabric's surface. A hooking device grabs onto the loops and holds the yarn in place while the needles are withdrawn. Tuft stitches are thus formed on the underside of the primary backing fabric. The loops are then either released to form "loop pile" soft carpets (tufted carpets having no secondary backing) or the loops are cut to form "cut pile" soft carpets. Multi-needle tufting machines having different gages and stitch rates may be used to make carpets of different styles. In addition, the pile height and face weight of the yarn may be adjusted depending upon the desired style.

The carpet is then typically dyed, rinsed, and subjected to other standard finishing operations including stain-resist and fluorochemical treatment.

Different primary backing fabrics known in the art may be used in the present invention. These fabrics include woven and nonwoven fabrics, such as polypropylene, jute, and polyester.

A latex of a synthetic polymer is then applied to the underside of the primary backing fabric to lock the tufts in place. Any suitable adhesive latex may be used. The latex typically includes a filler material such as calcium carbonate, silica, talc, or clay. Examples of suitable polymers for preparing such latex compositions include styrene/butadiene copolymers, ethylene/vinyl acetate copolymers, polyacrylates, and blends thereof. Generally, the amount of latex applied to the primary backing is in the range of about 18 to 40 ounces per square yard of primary fabric. Preferably, about 22 to 32 oz/yd^2 of latex is applied to the primary backing.

In the process of this invention, a thermoplastic polymeric resin is applied to a secondary backing fabric. Suitable thermoplastic resins include, for example, ethylene/vinyl acetate copolymers, polyethylene, polypropylene, polyacrylates, and copolymers and blends thereof. It is recognized that the resin may also contain additives such as waxes, plasticizers, and fillers for adjusting the melt viscosity of the resin. Other additives for imparting different functionalities may be added to the resin composition including pigments, dyes, antioxidants, flame retardants, antistats, and antimicrobial agents. These type of additives may also be included in the latex composition.

In the present invention, it is critical that the thermoplastic resin be applied to the secondary backing fabric in the form of a film. By the term "film" as used herein, it is meant a continuous coating having a thickness no greater than about 10 mil (0.010 inches). Generally, the amount of resin applied to the

secondary backing fabric is greater than about 0.25 ounces per square yard of secondary fabric. Preferably, about 0.25 to 2.5 oz/yd^2 is applied.

Secondly, it is important that the film be capable of adhering to the latex composition and to the secondary backing fabric. Preferably, the thermoplastic resin is extruded directly onto the secondary backing fabric as a film coating. In such a method, a molten mixture may first be prepared by heating the resin to its molten state in a mixing vessel, while filler and additive materials are continuously added to the vessel and mixed with the resin therein. The molten mixture is then extruded or cast through a die and directly onto the fabric. The coated secondary backing is then typically passed between two pressure metal rolls, whereby the molten layer is pressed into the surface of the secondary backing. The molten resin is also cooled to below its melting/softening point. It is important that the film be applied uniformly to the secondary backing fabric, and that there be minimum shrinkage of the film during any subsequent drying and curing steps in order to maintain the structural integrity of the carpet.

Different secondary backing fabrics known in the art may be used including polypropylene, jute, and polyester woven and nonwoven fabrics.

The latex-coated underside of the tufted primary backing is then pressed against the surface of the resin-coated secondary backing. The entire composite backing structure is heated to activate both the thermoplastic resin and cure the latex. The respective backings are thus bonded together. This lamination process may be carried out by techniques and equipment known in the trade. For instance, conventional curing ovens that are often used in operations where the adhesive consists only of a polymeric latex between the primary and secondary backings are also suitable for the present invention. These ovens provide heat-activation of the resin as well as curing of the latex. The laminated carpet structure may then be cooled by passing the carpet through a zone of air at ambient temperature.

Although the heating temperature may vary depending upon the type of pile yarn, adhesive composition, and backing fabrics used, the temperature is generally in the range of about 250 °F to 325 °F. It is important that the drying and curing temperature not be so high as to damage the pile yarn. Pressure may be applied to the respective backings by pressure or nip rolls.

Alternatively, a film of the thermoplastic resin may first be prepared without any substrate. In such a process, the melt is extruded through a circular or flat die, and cooled to below its melting/softening point. The resulting film may be wound on a core and stored for future use. Eventually, the film is inserted onto the surface of the secondary fabric and bonded to the fabric during the above-described lamination step.

This unique combination of latex and thermoplastic resin between the respective backings provides a carpet having a secondary backing which is substantially impervious to liquids. By the phrase, "substantially impervious to liquids" as used herein, it is meant that water or a water-based substance will not substantially penetrate into the secondary backing. If a liquid comes into contact with the pile yarn and diffuses through the primary backing fabric, it becomes entrapped within this distinctive latex/film composite structure and does not effectively penetrate into the secondary backing fabric. In contrast, an adhesive latex composition, by itself, does not provide a sufficient barrier against liquid penetration, as shown in the following examples.

Nevertheless, the backing structures of the present invention must contain a significant amount of latex, since it is believed that the combination of latex and thermoplastic resin, along with the secondary fabric, provides the carpet with excellent dimensional stability, as well as liquid impermeability. Moreover, the latex provides for excellent tuft encapsulation and tuft binding strength in the finished carpet.

It is recognized that other embodiments of this invention can be made. For instance, the thermoplastic resin may be applied as a film to the underside of the secondary backing fabric, rather than to its surface. In such an event, even if a liquid penetrates into and through the secondary backing fabric, the film will prevent further penetration onto an underpad or other flooring material.

The present invention is further illustrated by the following examples, but these examples should not be construed as limiting the scope of the invention.

TESTING METHODS

Staining Test:

Mix 45 grams of a cherry flavored, sugar sweetened, "KOOL-AID" powder in 500 ml water. Allow solution to reach room temperature (75 +/- 5 °F) before using. Place the finished carpet specimens on a commercially available rebond type polyurethane cushion. A black cardboard sheet with a white absorbent surface can also be used as an alternate for the rebond cushion, in which case, the white absorbent surface will be next to the carpet backing. Pour 50 ml of "KOOL-AID" on the finished carpet through a 1-1/2"

diameter cylinder to create a circular stain. Remove cylinder and work out the solution into tufts for uniform staining. Let the samples stay undisturbed for 24 +/- 4 hours. Clean stained samples using the tap water and remove excess liquid with towels and/or a vacuum extractor. Look for a visual red stain underneath the secondary backing and rebond cushion or on top of the white absorbent cardboard.

Tuft Binding Strength:

The tuft binding strength for the carpet samples are tested in accordance with ASTM Test Method D-1335.

EXAMPLES

EXAMPLE 1

Carpet preparation: A BCF (bulked continuous filament) nylon 6,6 yarn of 1410 total denier and composed of 68 filaments (trilobal cross-section) was produced by a conventional process. Two of these yarns were plied and twisted to provide a yarn having a balanced twist of 3.5 turns per inch (tpi). The resultant yarn was then conventionally heat-set in a Superba heat-set apparatus at 270 °F. A cut pile tufted carpet was constructed from the heat set yarn using "POLYBAC", a woven polypropylene primary backing available from Patchogue Plymouth (a division of Amoco), to the following specifications: 40 oz/yd^2, 3/4" pile height, 1/8 gauge, 8.25 stitches per inch. This carpet was dyed to a light blue-grey shade using a Kuster's Fluidyer on a continuous dye line. A conventional continuous dye process at 400% wet pick-up, and dye auxillaries were used for dyeing the carpet. The color formula was the following (based on the weight of the carpet):

0.02% Tectilon Blue 4R (200%),
0.006% Tectilon Red 2B (200%), and
0.0045% Tectilon Orange 3G (200%) (pH = 6.0).

After dyeing, the carpet was rinsed and extracted. The carpet was then treated with a bath containing a commercially available stain resist agent, SR-200 from DuPont, on a Kuster's Flexnip. This stain resist agent is a mixture of hydrolyzed styrene/maleic anhydride copolymer and a sulphonated phenol formaldehyde condensate, as described in Fitzgerald et al., U.S. Patent 4,883,839. The bath was prepared by water dilution of the stain resist chemical SR-200 and adjusted to a pH of 2.3 using sulfamic acid. The bath was applied in the Kuster's Flexnip at about 80 °F and at 400% wet pick-up owf (on weight of fiber). The bath was applied at 3.75% owf. The carpet was then subjected to steaming in a vertical steamer for a residence time of 3 minutes. After the steamer, the carpet was rinsed and extracted. The carpet was subsequently treated with NRD-342 fluorochemical, available from DuPont in a conventional spray application, and the carpet was dried in an oven.

An "ACTIONBAC", a woven polypropylene secondary backing, available from Patchogue Plymouth (a division of Amoco), was extrusion coated with "ELVAX"® 3180, an ethylene-vinyl acetate copolymer resin, available from DuPont. The "ELVAX" resin was extruded onto the secondary backing to a 3 mil thickness.

Approximately 22 oz/yd^2 of a styrene/butadiene copolymer (SBR) latex, Type V-9370, available from Colloids Inc., was applied to the primary backing. The primary and secondary backings were then pressed together with a metal plate at a pressure of approximately .3 to .5 lb/in^2. The laminated backing structure was then dried and cured at 250 °F for 20 minutes in a drying oven and subsequently cooled. The finished carpet was then subjected to the above-described Staining Test, with the results reported below in Table I.

COMPARATIVE EXAMPLE A

A carpet was prepared in the manner described in above Example 1, except no thermoplastic resin was applied to the secondary backing, and about 28 oz/yd^2 of SBR latex was applied to the primary backing. The "ACTIONBAC" secondary backing fabric was bonded directly to the latex-coated primary backing, and the carpet was subsequently dried and cured in the drying oven, as described above. The finished carpet was subjected to the Staining Test, and the results are reported below in Table I.

EXAMPLE 2

A carpet was prepared in the manner described in Example 1, except the carpet was not treated with a stain resist agent. The finished carpet was subjected to the Staining Test, and the results are reported in the

following Table I.

COMPARATIVE EXAMPLE B

A carpet was prepared in the manner described in Example 1, except no thermoplastic resin was applied to the secondary backing; about 28 oz/yd^2 of SBR latex was applied to the primary backing; and the carpet was not treated with a stain resist agent. The "ACTIONBAC" secondary backing fabric was bonded directly to the latex-coated primary backing, and the carpet was subsequently dried and cured in the drying oven. The finished carpet, with no stain resist treatment, was subjected to the Staining Test, and the results are reported in Table I.

EXAMPLE 3

A carpet was prepared in the manner described in Example 1, except the thermoplastic resin, "ELVAX" 3180, was not extruded onto the "ACTIONBAC" secondary backing. Rather, a "BYNEL" 1123 film was laminated onto the secondary backing using a steam press unit at 212°F for a period of 2 to 3 minutes. The "BYNEL" 1123 film is an acid modified ethylene vinyl acetate with a melt index of 6.6, and a melt point of 74°C and is commercially available from DuPont. A finished carpet was prepared using 20 - 22 oz/yd^2 of the SBR latex Type V-9370 (available from Colloids Inc.) as an adhesive between the primary backing and the film-laminated secondary backing, as described above. The carpet sample was dried in an oven at 250°F for 20 minutes under pressure, and cooled. The finished carpet was then subjected to the Staining Test, and the results are reported below in Table I.

TABLE I

Sample	Staining Underneath The Rebond Cushion And/Or On White Absorbent Cardboard
Example #1	No Stain
Comparative Example A	Visible Red Stain
Example #2	No Stain
Comparative Example B	Visible Red Stain
Example #3	No Stain

A mill produced, 32 oz/yd^2 BCF nylon carpet having a polypropylene primary backing bonded by a latex adhesive to a woven secondary polypropylene backing was used in the following three examples. Three carpet samples each measuring 6" x 6" were cut from this carpet.

EXAMPLE 4

In this example, a 3 mil thick film of "BYNEL" 1123 (an acid modified ethylene vinyl acetate, melt index 6.6, melt point 74°C, available from DuPont) was laminated onto the underside of the secondary backing of one sample. The sample was prepared by placing the film on the underside of the secondary backing and pressing the film with a heating iron having a temperature of 250°F in order to melt the film such that the film would stick uniformly to the backing. The sample was then cooled to room temperature and subjected to the Staining Test. The results are reported below in Table II.

EXAMPLE 5

In this example, a 3 mil thick film of "BYNEL" E-411 (an anhydride modified polypropylene, melt index 10.0, melt point 150°C, available from DuPont) was laminated onto the underside of the secondary backing of the second above-described sample. The sample was prepared by placing the film on the underside of the secondary backing and pressing the film with a heating iron having a temperature of 325°F to melt the film in order for the film to stick uniformly to the backing. The sample was then cooled to room temperature and subjected to the Staining Test. The results are reported below in Table II.

COMPARATIVE EXAMPLE C

In this Example, the third 6" x 6" sample, as described above was used. In this sample, no film was laminated onto the surface or underside of the secondary backing. The Staining Test was conducted on the sample, and the results are reported below in Table II.

TABLE II

Sample	Staining On White Absorbent Cardboard
Example #4	No Stain
Example #5	No Stain
Comparative Example C	Visible Red Stain

EXAMPLE 6

A woven "ACTIONBAC" secondary backing was extrusion coated with a 6 mil layer of "ELVAX" 3180 resin. The resin was applied to the surface of the secondary backing. A portion of this coated secondary backing was then corona-treated on a Corotec Corp. machine (Model No. 57890-635AL) using the full load power density at 1.42 watts at a speed of 48 feet per minute. The surface tension of the "ELVAX" coated side of the backing increased from 40 to 60 dynes/cm. after corona treatment. Two carpet samples were then prepared.

In one sample, the corona-treated surface of the secondary backing was laminated to a tufted primary backing, as described in above Example 3. About 20-22 oz/yd^2 of latex was used to bond the backings together.

In the other sample, the untreated surface of the secondary backing was laminated to a tufted primary backing, as described in Example 3. About 20-22 oz/yd^2 of latex was used to bond the backings together.

The "corona-treated" and "corona-untreated" samples were then tested for stain penetration, per the Staining Test, and were also tested for tuft binding strength using the above-described ASTM Test Method D-1335. Both "treated" and "untreated" samples did not show any stain permeation through the secondary backing. However, the "treated" sample did show an increased tuft binding strength of 6.2 lbs vs. 4.2 lbs. for the "untreated" sample. This comparison illustrates the benefits of corona-treating the resin-coated secondary backing.

Claims

1. A process for constructing a carpet, comprising the steps of:
   a) drawing pile yarn through a primary backing fabric having a surface and an underside to form tufts of yarn projecting from the surface of the fabric;
   b) applying a latex comprising a synthetic polymer to the underside of the primary backing fabric;
   c) applying a thermoplastic polymeric resin in a film form to a secondary backing fabric having a surface and an underside, wherein the resin is applied to the surface of the fabric; and
   d) bonding the latex-coated underside of the primary backing fabric to the resin-applied surface of the secondary backing fabric to form a carpet having a secondary backing substantially impervious to liquids.

2. A process for constructing a carpet, comprising the steps of:
   a) drawing pile yarn through a primary backing fabric having a surface and an underside to form tufts of yarn projecting from the surface of said fabric;
   b) applying a latex comprising a synthetic polymer to the underside of the primary backing fabric;
   c) bonding the latex-coated underside of the primary backing fabric to a secondary backing fabric having a surface and an underside, wherein the underside of the primary backing fabric is bonded to the surface of the secondary backing; and
   d) applying a thermoplastic resin in a film form to the underside of the secondary backing fabric.

3. The process of claim 1 or 2, wherein the synthetic polymer comprising the latex is selected from the group consisting of styrene/butadiene copolymers, ethylene/vinyl acetate copolymers, and

polyacrylates.

4. The process of claim 2, wherein the synthetic polymer comprising the latex is a styrene/butadiene copolymer.

5. The process of claim 1 or 2, wherein the thermoplastic polymeric resin is selected from the group consisting of ethylene/vinyl acetate copolymers, polyethylene, and polypropylene.

6. The process of claim 5, wherein the thermoplastic polymeric resin is a ethylene/vinyl acetate copolymer film.

7. The process of claim 1 or 2, wherein the primary and secondary backing fabrics are each selected from the group consisting of polypropylene, jute, and polyester.

8. The process of claim 1 or 2, wherein the amount of latex applied to the primary backing fabric is about 22 to 32 ounces per square yard of primary backing fabric.

9. The process of claim 1 or 2, wherein the amount of thermoplastic resin applied to the secondary backing fabric is about 0.25 to 2.5 ounces per square yard of secondary backing fabric.

10. The process of claim 1 or 2, wherein the pile yarns are selected from the group consisting of polyamide, polypropylene, polyester, and polyacrylonitrile yarns.